Mumbai University

Question Paper

[IDOL – Revised Course]
(October – 2016)

Digital

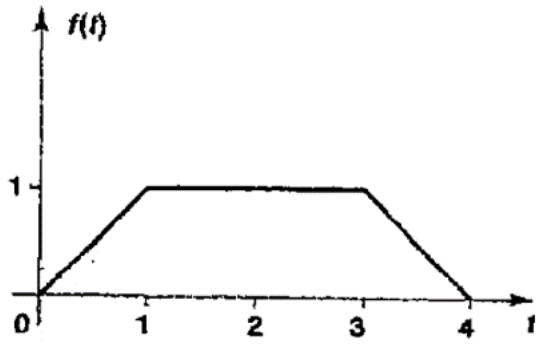
Signals and Systems

Time: 3 Hours **Total Marks:** 100

N.B.: **(1)** *All Question are Compulsory.*
(2) *Make Suitable Assumptions Wherever Necessary And State The Assumptions Made.*
(3) *Answer To The Same Question Must Be Written Together.*
(4) *Number To The Right Indicates Marks.*
(5) *Draw Neat Labeled Diagrams Wherever Necessary.*
(6) *Use of Non – Programmable Calculator is allowed.*

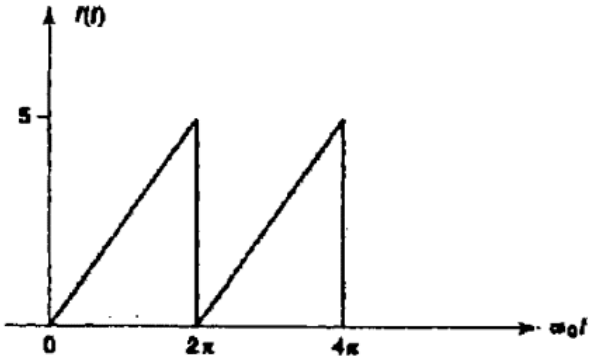
Q.1 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) Find the Laplace Transform for the following signal: **(5)**



(B) By first differentiating $x(z)$ and then using appropriate properties, determine $x(n)$ for $x(z) = log(1-2z)\ |z| < \frac{1}{2}$ **(5)**

(C) Determine the exponential Fourier Series for the waveform show below: **(5)**



(D) What are the applications of Digital Signal Processing? **(5)**

Q.2 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Explain the following properties of Fourier Transform: **(5)**
- **(i)** *Linearity*
- **(ii)** *Symmetry*
- **(iii)** *Scaling*

(B) Show that the product of two even signals or two odd signals is an even signal and that the product of an event and an odd signals is an odd signal. **(5)**

(C) What is even signal and odd signal? Determine the even and odd components of $x(t) = \cos t + \sin t$ **(5)**

(D) Draw and explain the block diagram of an Analog – To – Digital Converter. **(5)**

(E) What is meant by sampling? State Sampling Theorem. **(5)**

(F) Write a note on Dirichlet's Conditions. **(5)**

[TURN OVER]

Q.3 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Determine poles, zeroes of $F(s)$. Obtain $F(s) = 4.\frac{(S+1)(S+3)}{(S+2)(S+4)}$ **(5)**

(B) Obtain Laplace Transform for step and Impulse Response of Series R-C Circuit. **(5)**

(C) Find Inverse Laplace Transform of $F_1(S) = \frac{S^2+5}{S^3+ZS^2+4S}$ **(5)**

(D) Discuss initial Value Theorem in Laplace Transform Domain. **(5)**

(E) Define Laplace Transform and Inverse Laplace Transform. What is region of convergence? **(5)**

(F) Find the Laplace Transform of: **(5)**

(i) $e^{-t}\sin 4t$

(ii) $e^{2t} + 2te^{-2t} - t^2$

Q.4 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Compare the properties of two-sided z-transform with those of one-sided z-Transform. **(5)**

(B) Find the z-transform of the following: **(5)**

(i) $nu(n)$

(ii) $nd^n u(n)$

(C) Determine the convolution of the two sequences $x(n) = \{2,1,1,0,5\}$ and $x(n) = \{1,2,5,4,1,1\}$. **(5)**

(D) What is Z-transform? Explain the use of Z-transform. Determine the z-transform of $x(n) = \{1,2,5,4,1,1\}$. **(5)**

(E) Let $x(n)$ be the sequence with z-transform $X(z)$. Determine in terms of $X(z)$, the z-transforms of the following signals: **(5)**

(i) $x_1(n) = x\left(\frac{n}{2}\right)$ If n is even, 0 otherwise.

(ii) $x_2(n) = x(2n)$

(F) Determine the causal signal having z-transform $X(z) = \frac{z^2+z}{\left(z-\frac{1}{2}\right)^3\left(z-\frac{1}{4}\right)}$ for the region of coverage $|z| > \frac{1}{2}$ **(5)**

Q.5 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Explain the Paley-Wiener Criterion. **(5)**

(B) Explain stability in Linear Time Invariant System. What is the condition for a system o be BIBO Stable? **(5)**

(C) Determine whether the system described by $F[x(n)] = a[x(n)]^2 + b\,x(n)$ is linear and time invariant. **(5)**

(D) Obtain Frequency Response for $y(n) = x(n) + 10y(n-1)$ with initial condition $y(-1) = 0$. **(5)**

(E) Determine the impulse response and unit step response of the system described by the difference equations **(5)**

(i) $y(n) = 0.6y(n-1) - 0.08y(n-2) + x(n)$

(ii) $y(n) = 0.7y(n-2) - 0.1y(n) + 2x(n) - x(n-2)$

(F) Find the impulse response, frequency response, magnitude response and phase response of the second order system characterised by the difference equation: **(5)**

$$y(n) - y(n-1) + \frac{3}{16}y(n-2) = x(n) - \frac{1}{2}x(n-1)$$

[TURN OVER]

Q.6 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Consider two periodic sequences $x(n)$ and $y(n)$ with period M and N respectively. The sequence $w(n)$ is defined as $w(n) = x(n) + y(n)$. Show that $w(n)$ is periodic with period MN. **(5)**

(B) Determine the circular correlation values of the two sequences $x(n) = \{1,2,0,1\}$ and $h(n) = \{3,3,2,1\}$. **(5)**

(C) What are the methods used to perform Fast Convolution. Explain any one method giving all the steps involved to perform Fast Convolution. **(5)**

(D) Define Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT). Also state the Complex Conjugate property and Circular Convolution property of Discrete Fourier Transform (DFT). **(5)**

(E) Compute 8-point DFT of the sequence $x(n) = \{1,1,1,1,1,1,1,1\}$ by using DIF FFT Algorithm. **(5)**

(F) Find the circular periodic convolution using DFT and IDFT of the two sequences: $x(n) = \{1,1,2,2\}$ and $h(n) = \{1,2,3,4\}$ **(5)**

Q.7 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Explain the effects of windowing. Define Rectangular and Hamming Window functions. **(5)**

(B) What are the advantages of FIR Filter over IIR Filters? **(5)**

(C) Describe Elliptical Filters in detail. **(5)**

(D) What is an IIR Filter? Compare its characteristics with an FIR Filter. **(5)**

(E) Design a Finite Impulse Response low pass filter with a cut-off frequency of 1kHz and sampling rate of 4kHz with eleven samples using Fourier series. **(5)**

(F) **(5)**